

What is claimed is:

1. An optical pickup device, comprising:

a light source to emit a light flux having wavelength  $\lambda$ ;

an objective lens including at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side; and an actuator to drive the objective lens;

wherein the objective lens satisfies the following expression (1-1):

$$-0.0004 < \Delta 3SA / (NA^4 \cdot f \cdot (1 - m)) < 0.0004 \quad (1-1)$$

where  $\Delta 3SA$  ( $\lambda_{RMS}$ ) represents a rate of change of a third order spherical aberration of the objective lens when the temperature of an entire body of the objective lens uniformly changes,  $f$  (mm) represents the focal length of the objective lens for the light flux having wavelength  $\lambda$ , and  $m$  represents the magnification of the objective lens.

2. The optical pickup device of claim 1, wherein temperature distribution in the objective lens becomes uneven when the actuator is energized.

3. The optical pickup device of claim 1, wherein the objective lens satisfies the expression (1-1) so that a spherical aberration change is refrained in the case where ambient temperature of the optical pickup device fluctuates in the course of energizing the actuator.

4. The optical pickup device of claim 1, wherein at least one of the followings expressions is satisfied:

$$|TA| > 1.0,$$

$$|TR1| > 0.3$$

$$|TR2| > 0.3$$

where TA ( $^{\circ}$ C) represents temperature distribution in the optical axis direction of the objective lens and each of TR1 ( $^{\circ}$ C) and TR2 ( $^{\circ}$ C) represents temperature distribution in the radial direction when the actuator is energized, and TA, TR1 and TR2 are defined by the following expressions:

$$TA = T1 - T2 \quad (^{\circ}C)$$

$$TR1 = (T3 + T4 + T5 + T6) / 4 - T1 \quad (^{\circ}C)$$

$$TR2 = (T3 + T4 + T5 + T6) / 4 - T2 \quad (^{\circ}C)$$

where when the actuator is energized, T1 (°C) represents temperature on a vertex of a light source side optical surface of the first plastic lens), T2 (°C) represents temperature on a vertex of an optical disc side surface the second plastic lens, T3 (°C), T4 (°C), T5 (°C) and T6 (°C) represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by rotating the fist line by 90° around the optical axis intersect with an outer circumference of the first plastic lens and T1 to T6 are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized.

5. The optical pickup device of claim 1, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

6. The optical pickup device of claim 1, wherein the actuator comprises a focusing coil and a tracking coil, and at least one of the focusing coil and the tracking coil is arranged to be positioned so that its center of gravity is

positioned to be closer to the light source than the center of gravity of the second plastic lens.

7. The optical pickup device of claim 1, wherein the following expressions (1-2) - (1-4) are satisfied:

$$-20 \times 10^{-5} / {}^\circ\text{C} < \Delta NL1 < -2 \times 10^{-5} / {}^\circ\text{C} \quad (1-2)$$

$$0.6 < \Delta NL2 / \Delta NL1 < 1.5 \quad (1-3)$$

$$0.1 < (\Delta NL2 / \Delta NL1) \cdot f_B / (f \cdot (1 - m)) < 0.2 \quad (1-4)$$

where  $\Delta NL1$  represents a rate of change of refractive index of the first plastic lens for temperature changes,  $\Delta NL2$  represents a rate of change of refractive index of the second plastic lens for temperature changes, and  $f_B$  (mm) represents a back focus of the objective lens.

8. The optical pickup device of claim 1, wherein the following expression (1-5) is satisfied:

$$3.5 < f_1 \cdot (1 - m_1) / (f_2 \cdot (1 - m_2)) < 5.8 \quad (1-5)$$

where  $f_1$  (mm) represents a focal length of the first plastic lens for the light flux having wavelength  $\lambda$ ,  $m_1$  represents the magnification of the first plastic lens,  $f_2$  (mm) represents a focal length of the second plastic lens for the

light flux having wavelength  $\lambda$ , and  $m_2$  represents the magnification of the second plastic lens.

9. The optical pickup device of claim 1, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (1-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

10. An optical information recording and reproducing apparatus for conducting at least one of recording information on the optical information recording medium and

reproducing information recorded on the optical information recording medium, comprising:

the optical pickup device described in claim 1.

11. An objective lens for use in an optical pickup device, comprising:

at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side;

wherein the objective lens satisfies the following expression (1-1):

$$-0.0004 < \Delta 3SA / (NA^4 \cdot f \cdot (1 - m)) < 0.0004 \quad (1-1)$$

where  $\Delta 3SA$  ( $\lambda$ RMS) represents a rate of change of a third order spherical aberration of the objective lens when the temperature of an entire body of the objective lens uniformly changes,  $f$  (mm) represents the focal length of the objective lens for the light flux having wavelength  $\lambda$ , and  $m$  represents the magnification of the objective lens.

12. The objective lens of claim 1, wherein temperature distribution in the objective lens becomes uneven when an actuator is energized.

13. The objective lens of claim 11, wherein the objective lens satisfies the following expression (1-7):

$$-0.0003 < \Delta 3SA / (NA^4 \cdot f \cdot (1 - m)) < 0.0003 \quad (1-7)$$

14. The objective lens of claim 11, wherein at least one of the followings expressions is satisfied:

$$|TA| > 1.0,$$

$$|TR1| > 0.3$$

$$|TR2| > 0.3$$

where TA ( $^{\circ}\text{C}$ ) represents temperature distribution in the optical axis direction of the objective lens and each of TR1 ( $^{\circ}\text{C}$ ) and TR2 ( $^{\circ}\text{C}$ ) represents temperature distribution in the radial direction when the actuator is energized, and TA, TR1 and TR2 are defined by the following expressions:

$$TA = T1 - T2 \quad (^{\circ}\text{C})$$

$$TR1 = (T3 + T4 + T5 + T6) / 4 - T1 \quad (^{\circ}\text{C})$$

$$TR2 = (T3 + T4 + T5 + T6) / 4 - T2 \quad (^{\circ}\text{C})$$

where when the actuator is energized, T1 ( $^{\circ}\text{C}$ ) represents temperature on a vertex of a light source side optical

surface of the first plastic lens), T<sub>2</sub> (°C) represents temperature on a vertex of an optical disc side surface the second plastic lens, T<sub>3</sub> (°C), T<sub>4</sub> (°C), T<sub>5</sub> (°C) and T<sub>6</sub> (°C) represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by rotating the fist line by 90° around the optical axis intersect with an outer circumference of the first plastic lens and T<sub>1</sub> to T<sub>6</sub> are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized.

15. The objective lens of claim 11, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

16. The objective lens of claim 11, wherein the following expressions (1-2) - (1-4) are satisfied:

$$-20 \times 10^{-5} / ^\circ\text{C} < \Delta NL1 < -2 \times 10^{-5} / ^\circ\text{C} \quad (1-2)$$

$$0.6 < \Delta NL2 / \Delta NL1 < 1.5 \quad (1-3)$$

$$0.1 < (\Delta NL2 / \Delta NL1) \cdot f_B / (f \cdot (1 - m)) < 0.2 \quad (1-4)$$

where  $\Delta NL1$  represents a rate of change of refractive index of the first plastic lens for temperature changes,  $\Delta NL2$  represents a rate of change of refractive index of the second plastic lens for temperature changes, and  $f_B$  (mm) represents a back focus of the objective lens.

17. The objective lens of claim 16, wherein the following expressions (1-8) - (1-10) are satisfied:

$$-15 \times 10^{-5} / {}^\circ C < \Delta NL1 < -5 \times 10^{-5} / {}^\circ C \quad (1-8)$$

$$0.7 < \Delta NL2 / \Delta NL1 < 1.4 \quad (1-9)$$

$$0.12 < (\Delta NL2 / \Delta NL1) \cdot f_B / (f \cdot (1 - m)) < 0.18 \quad (1-10)$$

18. The objective lens of claim 11, wherein the following expression (1-5) is satisfied:

$$3.5 < f_1 \cdot (1 - m_1) / (f_2 \cdot (1 - m)) < 5.8 \quad (1-5)$$

where  $f_1$  (mm) represents a focal length of the first plastic lens for the light flux having wavelength  $\lambda$ ,  $m_1$  represents an optical system magnification of the first plastic lens,  $f_2$  (mm) represents a focal length of the second plastic lens for the light flux having wavelength  $\lambda$ , and  $m_2$  represents an optical system magnification of the second plastic lens.

19. The objective lens of claim 11, wherein the second plastic lens is a meniscus lens that is convex toward the first plastic lens.

20. The objective lens of claim 11, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (1-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

21. An optical pickup device,

a light source to emit a light flux having wavelength  $\lambda$ ;

an objective lens including at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side; and an actuator to drive the objective lens;

wherein the following expression (2-1) is satisfied:

$$0.6 < d_1/f < 1.2 \quad (2-1)$$

where  $f$  (mm) represents a focal length of the objective lens for the light flux having wavelength  $\lambda$ , and  $d_1$  (mm) represents a distance between a light source-side optical surface of the first plastic lens and an optical information recording medium-side optical surface the first plastic lens on the optical axis.

22. The optical pickup device of claim 21, wherein the following expression (2-1') is satisfied.

$$0.6 < d_1/f < 0.92 \quad (2-1')$$

23. The optical pickup device of claim 21, wherein the objective lens satisfies the expression (2-1) or (2-1') so that an astigmatism change caused when temperature distribution in the objective lens becomes uneven in the course of energizing the actuator is refrained.

24. The optical pickup device of claim 21, wherein the following expressions (2-3) and (2-4) are satisfied:

$$TP = |TH - TL| > 0.5 \quad (2-3)$$

$$TR = |TH - TC| > 0.5 \quad (2-4)$$

where TP( $^{\circ}$ C) represents temperature distribution in the circumferential direction of the objective lens in the course of energizing the actuator, and TR( $^{\circ}$ C) represents temperature distribution in the direction perpendicular to the optical axis, and when T1 ( $^{\circ}$ C) represents temperature on a vertex of a light source side optical surface of the first plastic lens), T2 ( $^{\circ}$ C) represents temperature on a vertex of an optical disc side surface the second plastic lens, T3 ( $^{\circ}$ C), T4 ( $^{\circ}$ C), T5 ( $^{\circ}$ C) and T6 ( $^{\circ}$ C) represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by

rotating the fist line by 90° around the optical axis intersect with an outer circumference of the first plastic lens and T1 to T6 are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized, TH represents the highest temperature and TL is the lowest temperature among T3 o T6 and TC is an average temperature of T1 and T2.

25. The optical pickup device of claim 21, wherein the following expressions (2-5) is satisfied:

$$0.1 < d_{12}/f < 0.4 \quad (2-5)$$

where  $d_{12}$  represents a distance between the first plastic lens and the second plastic lens on the optical axis.

26. The optical pickup device of claim 21, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

27. The optical pickup device of claim 21; wherein the actuator comprises at least a focusing coil and a tracking coil, and at least one of the focusing coil and the tracking coil is arranged to be positioned so that its center of

gravity is positioned to be closer to the light source than the center of gravity of the second plastic lens.

28. The optical pickup device of claim 21, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (2-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

29. The optical pickup device of claim 28, wherein the following expression (1-6) is satisfied:

$$0.4 < E_1/D_1 < 0.65 \quad (2-7)$$

where  $E_1$  (mm) represents an effective diameter of the light-source-side optical surface of the first plastic lens.

30. An optical information recording and reproducing apparatus for conducting at least one of recording information on the optical information recording medium and reproducing information recorded on the optical information recording medium, comprising:

the optical pickup device described in claim 21.

31. An optical pickup device, comprising:

a light source to emit a light flux having wavelength  $\lambda$ ;

an objective lens including at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side; and

an actuator to drive the objective lens;

wherein the following expression (2-2) is satisfied:

$$2.2 < f_1 \cdot (1 - \beta_1) / (f_2 \cdot (1 - \beta_2)) < 4.2 \quad (2-2)$$

where  $f_1$  (mm) represents a focal length of the first plastic lens for the light flux having wavelength  $\lambda$ ,  $\beta_1$  represents a magnification of the first plastic lens,  $f_2$  (mm) represents a focal length of the second plastic lens for the light flux having wavelength  $\lambda$  and  $\beta_2$  represents a magnification of the second plastic lens.

32. The optical pickup device of claim 31, wherein the following expression (2-2') is satisfied.

$$2.2 < f_1 \cdot (1 - \beta_1) / (f_2 \cdot (1 - \beta_2)) < 4.0 \quad (2-2')$$

33. The optical pickup device of claim 31, wherein the objective lens satisfies the expression (2-2) or (2-2') so that an astigmatism change caused when temperature distribution in the objective lens becomes uneven in the course of energizing the actuator is refrained.

34. The optical pickup device of claim 31, wherein the following expressions (2-3) and (2-4) are satisfied:

$$TP = |TH - TL| > 0.5 \quad (2-3)$$

$$TR = |TH - TC| > 0.5 \quad (2-4)$$

where  $TP(^{\circ}C)$  represents temperature distribution in the circumferential direction of the objective lens in the course of energizing the actuator, and  $TRC(^{\circ}C)$  represents temperature distribution in the direction perpendicular to the optical axis, and when  $T_1 (^{\circ}C)$  represents temperature on a vertex of a light source side optical surface of the first plastic lens  $L_1$ ),  $T_2 (^{\circ}C)$  represents temperature on a vertex of an optical disc side surface the second plastic lens,  $T_3 (^{\circ}C)$ ,  $T_4 (^{\circ}C)$ ,  $T_5 (^{\circ}C)$  and  $T_6 (^{\circ}C)$  represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by rotating the fist line by  $90^{\circ}$  around the optical axis intersect with an outer circumference of the first plastic lens and  $T_1$  to  $T_6$  are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized,  $TH$  represents the highest temperature and  $TL$  is the lowest temperature among  $T_3$  o  $T_6$  and  $TC$  is an average temperature of  $T_1$  and  $T_2$ .

35. The optical pickup device of claim 31, wherein the following expressions (2-5) is satisfied:

$$0.1 < d_{12}/f < 0.4 \quad (2-5)$$

where  $d_{12}$  represents a distance between the first plastic lens and the second plastic lens on the optical axis and  $f$  (mm) represents a focal length of the objective lens for the light flux having wavelength  $\lambda$ .

36. The optical pickup device of claim 32, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

37. The optical pickup device of claim 32, wherein the actuator comprises at least a focusing coil and a tracking coil, and at least one of the focusing coil and the tracking coil is arranged to be positioned so that its center of gravity is positioned to be closer to the light source than the center of gravity of the second plastic lens.

38. The optical pickup device of claim 32, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a

peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (2-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

39. The optical pickup device of claim 38, wherein the following expression (1-6) is satisfied:

$$0.4 < E_1/D_1 < 0.65 \quad (2-7)$$

where  $E_1$  (mm) represents an effective diameter of the light-source-side optical surface of the first plastic lens.

40. An optical information recording and reproducing apparatus for conducting at least one of recording information on the optical information recording medium and

reproducing information recorded on the optical information recording medium, comprising:

the optical pickup device described in claim 32.

41. An objective lens for use in an optical pickup device, comprising:

at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side;

wherein the following expression (2-1) is satisfied:

$$0.6 < d_1/f < 1.2 \quad (2-1)$$

where  $f$  (mm) represents a focal length of the objective lens for the light flux having wavelength  $\lambda$ , and  $d_1$  (mm) represents a distance between a light source-side optical surface of the first plastic lens and an optical information recording medium-side optical surface the first plastic lens on the optical axis.

42. The objective lens of claim 41, wherein the following expression (2-1') is satisfied.

$$0.6 < d_1/f < 0.92 \quad (2-1')$$

43. The objective lens of claim 41, wherein the following expressions (2-3) and (2-4) are satisfied:

$$TP = |TH - TL| > 0.5 \quad (2-3)$$

$$TR = |TH - TC| > 0.5 \quad (2-4)$$

where TP ( $^{\circ}$ C) represents temperature distribution in the circumferential direction of the objective lens in the course of energizing the actuator, and TR ( $^{\circ}$ C) represents temperature distribution in the direction perpendicular to the optical axis, and when T1 ( $^{\circ}$ C) represents temperature on a vertex of a light source side optical surface of the first plastic lens), T2 ( $^{\circ}$ C) represents temperature on a vertex of an optical disc side surface the second plastic lens, T3 ( $^{\circ}$ C), T4 ( $^{\circ}$ C), T5 ( $^{\circ}$ C) and T6 ( $^{\circ}$ C) represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by rotating the fist line by 90 $^{\circ}$  around the optical axis intersect with an outer circumference of the first plastic lens and T1 to T6 are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized, TH

represents the highest temperature and TL is the lowest temperature among T3 o T6 and TC is an average temperature of T1 and T2.

44. The objective lens of claim 41, wherein the following expressions (2-5) is satisfied:

$$0.1 < d_{12}/f < 0.4 \quad (2-5)$$

where  $d_{12}$  represents a distance between the first plastic lens and the second plastic lens on the optical axis.

45. The objective lens of claim 41, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

46. The objective lens of claim 41, wherein the following expressions (2-8) is satisfied:

$$1.0 < (r_2 + r_1) / (r_2 - r_1) < 1.7 \quad (2-8)$$

where  $r_1$  represents a paraxial radius of curvature of the light-source-side optical surface of the second plastic lens and  $r_2$  represents a paraxial radius of curvature of the information-recording-medium-side optical surface.

47. The objective lens of claim 41, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (2-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

48. The objective lens of claim 47, wherein the following expression (1-6) is satisfied:

$$0.4 < E_1/D_1 < 0.65 \quad (2-7)$$

where  $E_1$  (mm) represents an effective diameter of the light-source-side optical surface of the first plastic lens.

49. An objective lens for use in an optical pickup device, comprising:

at least two plastic lenses of a first plastic lens having positive refractive power and a second plastic lens having positive refractive power, wherein the first plastic lens and the second plastic lens are arranged in this order from the light source side;

wherein the following expression (2-2) is satisfied:

$$2.2 < f_1 \cdot (1 - \beta_1) / (f_2 \cdot (1 - \beta_2)) < 4.2 \quad (2-2)$$

where  $f_1$  (mm) represents a focal length of the first plastic lens for the light flux having wavelength  $\lambda$ ,  $\beta_1$  represents a magnification of the first plastic lens,  $f_2$  (mm) represents a focal length of the second plastic lens for the light flux having wavelength  $\lambda$  and  $\beta_2$  represents a magnification of the second plastic lens.

50. The objective lens of claim 49, wherein the following expression (2-2') is satisfied.

$$2.2 < f_1 \cdot (1 - \beta_1) / (f_2 \cdot (1 - \beta_2)) < 4.0 \quad (2-2')$$

51. The objective lens of claim 49, wherein the following expressions (2-3) and (2-4) are satisfied:

$$TP = |TH - TL| > 0.5 \quad (2-3)$$

$$TR = |TH - TC| > 0.5 \quad (2-4)$$

where  $TP(^{\circ}C)$  represents temperature distribution in the circumferential direction of the objective lens in the course of energizing the actuator, and  $TR(^{\circ}C)$  represents temperature distribution in the direction perpendicular to the optical axis, and when  $T_1 (^{\circ}C)$  represents temperature on a vertex of a light source side optical surface of the first plastic lens  $L_1$ ,  $T_2 (^{\circ}C)$  represents temperature on a vertex of an optical disc side surface the second plastic lens,  $T_3 (^{\circ}C)$ ,  $T_4 (^{\circ}C)$ ,  $T_5 (^{\circ}C)$  and  $T_6 (^{\circ}C)$  represent temperatures respectively at points where a first line which passes through a middle point of a lens thickness of the first plastic lens on an optical axis and is perpendicular to the optical axis and lines which representing lines obtained by rotating the fist line by  $90^{\circ}$  around the optical axis intersect with an outer circumference of the first plastic lens and  $T_1$  to  $T_6$  are measured after the temperature distribution fluctuation in the objective lens becomes a stable condition when the actuator is energized,  $TH$  represents the highest temperature and  $TL$  is the lowest temperature among  $T_3$  o  $T_6$  and  $TC$  is an average temperature of  $T_1$  and  $T_2$ .

52. The objective lens of claim 49, wherein the following expressions (2-5) is satisfied:

$$0.1 < d_{12}/f < 0.4 \quad (2-5)$$

where  $d_{12}$  represents a distance between the first plastic lens and the second plastic lens on the optical axis.

53. The objective lens of claim 49, wherein the numerical aperture NA on the image side of the objective lens is 0.8 or more.

54. The objective lens of claim 49, wherein the following expressions (2-8) is satisfied:

$$1.0 < (r_2 + r_1) / (r_2 - r_1) < 1.7 \quad (2-8)$$

where  $r_1$  represents a paraxial radius of curvature of the light-source-side optical surface of the second plastic lens and  $r_2$  represents a paraxial radius of curvature of the information-recording-medium-side optical surface.

55. The objective lens of claim 49, wherein the first plastic lens has a first flange portion on a peripheral portion that is outside the optical functional portion and the second plastic lens has a second flange portion on a

peripheral portion that is outside the optical functional portion, and the first plastic lens and the second plastic lens are integrated into one body by bringing a part of the first flange portion and a part of the second flange portion in contact with each other, and wherein the following expression (1-6) is satisfied and the first plastic lens is held by a bobbin that is driven by the actuator:

$$D_1 > D_2 \quad (2-6)$$

where  $D_1$  (mm) represents an outside diameter of the first plastic lens including the first flange portion and  $D_2$  (mm) represents an outside diameter of the second plastic lens including the second flange portion.

56. The objective lens of claim 55, wherein the following expression (1-6) is satisfied:

$$0.4 < E_1/D_1 < 0.65 \quad (2-7)$$

where  $E_1$  (mm) represents an effective diameter of the light-source-side optical surface of the first plastic lens.